1003-200

SORENSEN

A UNIT OF RAYTHEON COMPANY

INSTRUCTION MANUAL

SERIES 1000
HIGH VOLTAGE
DC POWER SUPPLIES

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SORENSEN/A UNIT OF RAYTHEON CO., Richards Avenue, So. Norwalk, Conn.

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GENERAL INFORMATION

WARRANTY

SORENSEN/A Unit of Raytheon Company, warrants each instrument it manufactures to be free from defects in material and workmanship. The company's obligation under this warranty is limited to servicing the instrument and replacing defective parts*, when the instrument is returned to the factory with transportation charges prepaid. This warranty is effective for one year after delivery of the instrument to the original purchaser. Defects caused by improper operating conditions, misuse, negligence, or the alteration or removal of the nameplate, will void the warranty. SORENSEN shall in no circumstance be liable for any direct or consequential loss or damage of any nature resulting from the malfunction of the instrument. This warranty is effective in lieu of any or all other obligations or liabilities on the part of SORENSEN/A Unit of Raytheon Company, its agents, or representatives.

SERVICE INFORMATION

Questions concerned with the operation, repair, or servicing of this instrument should be directed to the nearest Sorensen representative (a list is included with this manual) or to the Service Department., Sorensen/A Unit of Raytheon Company, Richards Avenue, South Norwalk, Connecticut. *Include the model number and serial number,* in any correspondence concerning this instrument.

SHIPPING DAMAGE

It is possible for equipment to be damaged in shipment. Therefore, it is imperative that the instrument be tested and inspected as soon as it is received. If the instrument shows signs of damage, follow the instructions on the DAMAGE and/or Loss in Shipment form enclosed with the unit and notify the carrier immediately. The carrier's claim agent will then prepare a report of damage and, after you have forwarded this to the Sorensen Service Department, you will be advised as to the action necessary to have the instrument repaired or replaced.

RETURNS TO THE FACTORY

Should it be necessary to return an instrument to the factory for repair, please contact the Sorensen Service Department for authorization to make shipment.

DO NOT RETURN THE UNIT FOR REPAIR WITHOUT THIS AUTHORIZATION.

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* The warranty excludes special purpose tubes, which carry their own manufacturer's warrantees, and fuses.

II. SPECIFICATIONS

MODEL		1151	1121	1101	1061	1030-20	1020-30	1012-50	1006-100	1003-200
INPUT POWER AC	Voltage	117 VAC, single phase nominal (Range 110 - 125 VAC) Frequency 60 cps nominal (Range 57 - 62 cps)								
	Current	12 amps	10 amps	3 amps	10 amps	10 amps	10 amps	10 amps	10 amps	10 amps
OUTPUT POWER DC	Voltage	0-150 KV	0-120 KV	0-100 KV	0-60 KV	0-30 KV	0-20 KV	0-12 KV	0-6 KV	0-3 KV
	Current	5 MA	5 MA	1.5 MA	10 MA	20 MA	30 MA	50 MA	100 MA	200 MA
Internal Impedance (ohms)		5 Meg	5 Meg	7 Meg	1.2 Meg	300 K	133 K	50 K	10 K	2 K
Ripple (% RMS*)		2.0	2.0	4.0	1.5	2.0	2.0	2.0	2.0	2.0
Rack Mount Cabinet Section Size (inches)	Width	19	19	19	19	19	19	19	19	19
	Height	8¾	8¾	8¾	8¾	8¾	8¾	8¾	8¾	8¾
	Depth	15⅝	15⅝	15⅝	15⅝	15⅝	15⅝	15⅝	15⅝	15⅝
	Weight (net lbs.)	50	50	50	50	80	80	80	80	80
Separate Tank Section Size (in.)	Width	22½	18¾	14	14	***	***	***	***	***
	Height	27	17¼	14¼	14¼	***	***	***	***	***
	Depth	22½	17¼	14	14	***	***	***	***	***
	Weight (net lbs.)	650**	275**	145**	145**	***	***	***	***	***
INSULATION		Oil	Oil	Oil	Oil	Air	Air	Air	Air	Air

*Ripple measured with nominal input line.

**Including oil. (Oil not supplied)

***No separate tank section. High voltage components included in rack mount cabinet section.

OPTIONAL FEATURES AVAILABLE

#C1 Regulates the output voltage to ±1.5%

#C2 Regulates the output voltage to ±0.2%
(With fixed load and line change of 105 to 125 VAC.)

#L1 Output ripple filter ..... 0.1% RMS

#L2 Output ripple filter ..... 0.01% RMS

#CH Castors for High Voltage Section

III. INSTALLATION AND OPERATION

The 1000 Series Power Supplies are applicable to any requirements where no more than 600 watts of very high voltage DC power is needed, such as nuclear physics, research, electrostatic painting and precipitation, cathode ray oscillography, etc. Attention has been given to safety without a sacrifice of any convenience in operation. Primary safety features include a variable overload relay, a variable overvoltage relay and an automatic output voltage shorting solenoid.

DESIGN FEATURES

1. HIGH VOLTAGE CIRCUIT

The various models employ either a full-wave doubler or a full-wave bridge.

The circuit for a particular supply is shown in the schematic diagram included with this manual.

2. POLARITY REVERSAL

For single cabinet models (30 KV and below), first remove the back panel from the unit. Polarity reversal is then accomplished by removing the polarity reversing plate located at the left rear of the chassis, rotating it 180° and replacing it. Polarity can be determined without energizing the unit. The polarity will be that which can be read on the plate in a right side up position. The meter polarity switch on the front panel should be changed to conform with the output mode being used. Replace the back panel.

For models with separate high voltage tanks, polarity reversal is accomplished by a reversing handle in the top of the tank which must be withdrawn, rotated 180° and then reseated.

3. OUTPUT VOLTAGE CONTROL

The output is adjusted by means of two variable auto transformers (fine and coarse front panel controls) which vary the AC input to the high voltage transformer rectifying circuit.

4. METERING

The output voltage and current are monitored by triple range meters. These ranges have a ratio of 1/3/10.

5. CONTROLS:

a. High voltage off and overvoltage or overload reset push-button.
b. High voltage on push-button.
c. High voltage control variable auto transformer.
d. Meter polarity selector switch.
e. Main power toggle switch.
f. Fine high voltage control variable auto transformer.
g. Output current meter range selector switch
h. Zero start interlock bypass push-button (Not available on 1121 or 1151)
i. Overload trip control rheostat.
j. Output voltage meter range selector switch.
k. Overvoltage trip control rheostat.

6. PILOT LIGHTS: (All neon with frosted lens)

a. Input fuses open (2)
b. Overload
c. High Voltage On
d. High Voltage transformer primary fuse open
e. External Interlock open
f. Main Power, On.
g. Overvoltage.

7. POWER CONNECTIONS:

a.	Input:	3 wire line cord with 3 prong polarized plug
b.	Output:	RG8/U cable, 8 ft. long on all models except as follows:
		Model 1101 --- RG34B/U cable, 8 ft long
		Model 1121 --- RG17/U cable, 8 ft long
		Model 1151 --- RG19/U cable, 10 ft. long
c.	Ground:	Screw binding post on chassis rear and tank cover.

A. MECHANICAL

1. Open the carton or crate and check all panel surfaces for visible damage.

2. Remove the back cover from the cabinet.

   FOR OIL-FILLED high voltage section, remove the screws atop the tank edge from their tapped holes and then raise the lid suspended high voltage components from the tank. Remove the tape or other binding from the polarity reversing mechanism.

3. Remove the tape or other binding from the output shorting mechanism's plunger, and any tape used to secure anti-corona nuts during shipment.

4. Insert the polarity reversing plate in proper jacks to correspond to high voltage positive or negative as desired. See page 4

   NOTE: For OIL insulated units, fill the tank with clean, dehydrated transformer oil, * of at least 25 KV test, Gulf Paramount # 33 or equivalent, to the level indicated by the line stamped in the tank, about 2" from the top of tank. Next proceed as follows:

   a. Lower the high voltage components slowly into the oil, in order to minimize splashing and oil aeration. (Oil should be made to reach to within 1/4 inch of top of tank).

   b. Replace screws in cover.

   c. Connect the control section to the tank by means of the inter-connecting cable.

5. Remove the top section of the back cover of the cabinet. Pass two wires from an external interlock through the rubber grommet located in the section removed. These two wires must be connected to the two terminals (pos. and neg.) stamped EXT INTLK at the right side of the terminal board. If no external interlock is used short these two (2) terminals together.

6. Replace the back cover sections.

* See pages 9, 10 & 11

B. ELECTRICAL

1. Ground the unit by means of the binding post provided on the rear of the chassis and the ground screw on the tank top.

NOTE: ALWAYS OPERATE WITH A GOOD EXTERNAL GROUND.

BE CERTAIN THAT ALL PERSONNEL ARE PROPERLY PLACED WITH RESPECT TO THE HIGH VOLTAGE OUTPUT CABLE. THIS MEANS THAT NO ONE SHOULD BE WITHIN 1/2 FOOT OF THE OUTPUT END, UNLESS HE KNOWS EXACTLY WHAT HE IS DOING.

ALTHOUGH A LETHAL AMOUNT OF POWER MAY NOT BE AVAILABLE FROM THE POWER SUPPLY ITSELF, SECONDARY MECHANICAL EFFECTS DUE TO MECHANICAL MOVEMENT CAN BE DANGEROUS. IF A CAPACITOR IS BEING TESTED AT VOLTAGES SUCH THAT $1/2CE^2$ IS GREATER THAN 27, A LETHAL AMOUNT OF STORED ENERGY MAY BE AVAILABLE.

2. Connect output cable to load in such a position that it will not be in close proximity to ground. Keep away from all personnel.

NOTE: High voltage output cables for units 30 KV and below are terminated in alligator clips, while those for oil units are stripped back but remain unterminated.

3. Turn the HIGH VOLTAGE CONTROL to zero. Be sure that the on-off switch is in the OFF position.

4. Connect the power supply to a source of nominal 117 volts, 60 cycles, single phase, by means of the line cord provided.

5. Set the METER POLARITY selector switch to " +" or " - ", corresponding to the polarity reversing plate in the high voltage section.

6. Set OUTPUT VOLTAGE AND OUTPUT CURRENT METER range selector switch to the range desired.

7. Set the on-off switch to ON.

8a. Set the OVERLOAD TRIP CONTROL to the desired trip current. Refer to drawings for the calibration of trip current vs. overload trip control setting, supplied with this manual. Overload is adjustable from 20 to 120% of rated current.

8b. Set the OVERVOLTAGE TRIP CONTROL to the desired trip voltage. Refer to drawings for the calibration of trip voltage vs. overvoltage trip control setting, supplied with this manual.

Overvoltage is adjustable from 20 to 110% of rated voltage.

9. Set the HIGH VOLTAGE CONTROL to zero. (Recommended, but not mandatory).

   Depress the HIGH VOLTAGE on push-button.

10. Turn the HIGH VOLTAGE CONTROL clockwise until the rated output voltage and/or current is indicated.

11. TURN OFF:

    a. Turn the HIGH VOLTAGE CONTROL to zero (advisable, not mandatory).

    b. Depress the HIGH VOLTAGE OFF push-button.

    c. Set the ON-OFF switch to OFF.

    d. In case of emergency, there should be no hesitation to depress the HIGH VOLTAGE OFF push-button at once.

12. TO RESET AFTER AN OVERLOAD

    a. Remedy the condition that caused the overload.

    b. Turn the HIGH VOLTAGE CONTROL to zero.

    c. Depress the OVERVOLTAGE OR OVERLOAD RESET push-button.

    d. Repeat steps 8 through 10 above.

13. TO RESET AFTER AN OVERVOLTAGE

    a. Remedy the condition that caused the overvoltage.

    b. Repeat steps 12b, c and d.

TRANSFORMER INSULATING OIL-HIGH VOLTAGE SUPPLIES

PURPOSE: To advise representatives and customers of the correct type of transformer insulating oil to use in our high voltage power supplies.

OUTLINE: We have had several incidents where the use of "Pyranol" (Monsanto type "Aroclors") as an insulating oil in our high voltage supplies has resulted in the complete destruction of the high voltage section.

Chlorinated dielectric oils are highly destructive to the lucite insulation and barriers used in the high voltage section, and their use will cause the section to disintegrate within a matter of days after use.

The serious nature of this problem has made it mandatory for us to take immediate action to insure that further problems and use of chlorine based oils are a thing of the past.

UNITS AFFECTED: All Oil Insulated Power Supplies previously manufactured by Beta Electric and currently manufactured by Sorensen.

DESTRUCTIVE OILS: Following is a list of the chlorine based oils which are destructive in our supplies, and under no circumstances should they be used: They are listed by "trade" names:

Name	Manufacturer
Chlorextol	Allis-Chalmers
Diaclor	Sangamo Electric
Dykanol	Cornell Dubilier
Elemex	Line Materials
Hyvol	Aerovox
Inerteen	Westinghouse
Noflamol	Wagner Electric
Pyranol	General Electric

This list cannot be assumed as complete. We have no control as to other similar oils contemplated or not in wide distribution. If a doubt arises, please consult us.

WHAT OIL TO USE:

Following is a list of some important characteristics that the transformer oil should have in order to be used in our High Voltage Sections.

1. A high dielectric strength of at least 25 KV test.
2. Low viscosity and density to aid in dissipating an arc due to flashover as well as for transferring heat.
3. Freedom from inorganic chlorides, sulfates, alkalis, and corrosive sulfur to prevent any damage to the insulating materials or conductors.
4. Good resistance to emulsion so that any moisture will, upon entering the oil, be held down instead of being suspended.
5. A relatively high flash and fire point.

Based upon the above requirements, the following mineral base transformer oils are recommended.

Manufacturer	Type
* Gulf	Paramount # 33
* Shell	Diala-Ax
* Esso	Univolt # 35
Tydol	Avon
Texaco	# 55

* These oils are used by our Service Department and High Voltage Laboratory

IMPORTANT

USE ONLY MINERAL BASE TRANSFORMER OILS IN THIS POWER SUPPLY.

PREPARING HIGH VOLTAGE OIL

Purpose: To provide field personnel with information on preparing the transformer insulating oil in the tanks of high voltage power supplies.

Units Affected: All oil insulated units.

Outline: For proper functioning of this equipment it is necessary to use a good grade of " non-additive" transformer oil and to make certain that all air is expelled from the oil before, the unit is brought up to full voltage. In order to accomplish this, it is desirable to take the necessary time and care required to bring the power supply up to operating condition.

Caution: The following steps should be followed:

1. Raise DC voltage to 50% of rated output voltage, no load on the output. Note the leakage current. Unit must be aged at this voltage for a minimum of one hour. The current meter should indicate less than 10 microamperes.

2. Repeat step 1 at 75% of rated output voltage for 1/2 hour.

3. Repeat step 1 at 100% of rated output voltage for 1/2 hour.

4. Repeat step 1 at 110% of rated output voltage for 1/2 hour.

The unit is ready to operate, after reaching and completing step 4.

NOTE: The above procedure must be followed, whenever the oil is changed or refiltered.

IV. PRINCIPLE OF OPERATION

All of the circuits and functions of the power supply are quite straight forward and can be readily understood by referring to the schematic circuit diagram.

The input power is applied, through various switches and contacts (to be discussed later) to the variable autotransformer T1. The coarse control (front panel) is used to vary the output of T1 from 0 to 135 volts AC, with the input at 120 volts. This supplies the input voltage to the high voltage transformer T5.

The output of T is rectified and doubled by means of rectifiers and capacitors in a conventional full wave doubler circuit (See Fig. 2). A brief description of this type of circuit is given below.

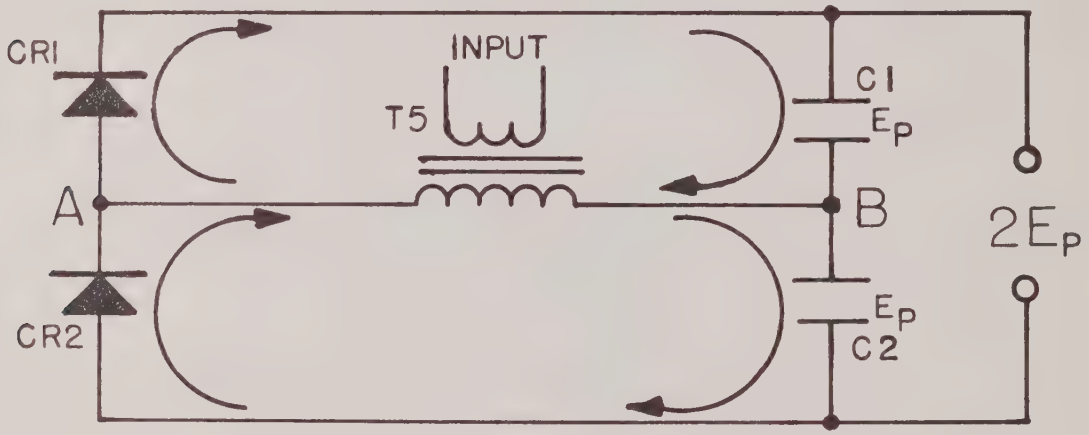

FIG. 2

When the polarity of Point A is negative with respect to point B, rectifier CR2 will conduct with a current in the direction indicated, and capacitor C2 will charge to the potential Ep. The potential Ep will equal the crest voltage of the secondary of the transformer T2. (For example: if the secondary voltage were 40 KV RMS, the peak voltage would be 40 KV times 1.414 or 56 KV peak). In the next half of the cycle, of the applied 60 cycle wave, point A will become positive with respect to point B and rectifier CR1 will conduct in the direction shown. Capacitor C1 will charge to the voltage Ep. It is now apparent that the potential appearing across C2 and C1 will be equal to twice Ep.

It is in this manner that the doubling is accomplished. It should be noted that the transformer, rectifiers, and capacitors were treated as lossless. The effect of load resistance was also neglected. These things would introduce losses and would require a higher secondary voltage on the transformer to overcome them.

However, for our ease of understanding, doubling is theoretically perfect.

The output of T2 may also be fed into a full wave bridge (See Fig. 3).

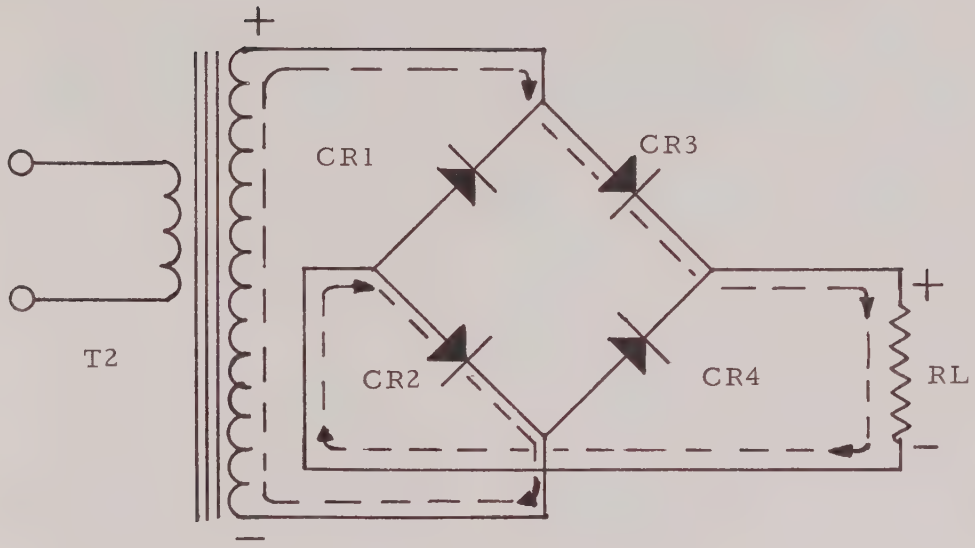

Fig. 3

During the first half cycle, suppose the polarity of T2 is as indicated in Fig. 3. CR3 and CR 2 are conducting and current flows from the positive to the negative end of the load RL. The conduction path is shown by the dotted line.

During the next half cycle the transformer voltage reverses its polarity and CR3 and CR2 will be non-conducting, while CR 4 and CR1 will send current through the load in the same direction as that during the previous half cycle.

The output DC voltage = $\frac{\text{Erms}}{1.1}$

For example: Edc = 3000 V

Then the secondary voltage Erms = 3000 x 1.1

= 3300 V

PROTECTIVE CIRCUITRY

1. BLOWN FUSE AND OPEN SWITCH INDICATORS:
All fuses have built in lamps which glow if a fuse is blown thus indicating the cause of in-operation of the power supply. The lamp holders have built-in resistors, limiting the lamp current to approximately 1 milliampere, so that none of the circuit BEYOND THE LAMP will be operated by the small current that flows through the lamp.

2. NEON PILOT LIGHT CURRENT RETURN RESISTORS

Resistor R1 ensures illumination of the neon glow lamp in case of blown fuse and an open circuit beyond the resistor.

3. HOLDING RELAY FOR OVERLOAD PROTECTION:

Relay K1 pulls in when contacts 3a of the overload relay K3 close momentarily. When K1 is energized, contacts 1b open, de-energizing the high voltage circuits. Contacts 1a close and maintain K1 energized, even though contacts 3a have now opened due to contacts 1b having opened, removing primary power from the high voltage circuit. Depressing S1, HIGH VOLTAGE OFF & OVER VOLTAGE -OVERLOAD RESET, de-energizes K1 and resets the system for operation after the overload.

Pilot Light 14, OVERLOAD, is illuminated for the overload condition.

4. HOLDING RELAY FOR OVERVOLTAGE PROTECTION:

Relay K7 pulls in when contacts 6a of the overvoltage relay (K6) close momentarily. When K7 is energized, contacts 7b open, de-energizing the high voltage circuits. Contacts 7a close and maintain K7 energized, even though contacts 6a have now opened due to contacts 7b having opened, removing primary power from the high voltage circuit. Depressing S1, HIGH VOLTAGE OFF, OVERVOLTAGE-OVERLOAD RESET, de-energizes K7 and resets the system for operation after the overvoltage.

5. HIGH VOLTAGE " HOLDING"

K2 contacts are normally closed shorting output to ground through R5. When the HIGH VOLTAGE ON pushbutton S2 is depressed, solenoid K2 is energized, removing the short from the output, through resistor R5. At the same time, K4 is energized, closing contact 4c, thus by-passing S2 and allowing S2 to be released, maintaining high voltage.

6. METERING CIRCUITS:

The output voltage metering circuit consists of resistor R4 and the range calibrating potentiometers R11, R12 and R13 and Meter M1. R11,R12 and R13 are located at the top front of the control section. They are directly beneath the top cover of the unit.

It is to be noted that the return of the output voltage metering circuit is not to ground, but to the " high" end of the OUTPUT CURRENT metering circuit M2. Thus, the output current meter does not indicate the current drawn by the kilovoltmeter circuit.

R14, R15 and R16 are potentiometers used to calibrate the current meter (M2) ranges. These potentiometers are located on the same bracket as R11, 12 and 13 at the top front of the control section.

NOTE: All calibrating potentiometers have been adjusted at the factory and should not be re-adjusted unless absolutely necessary.

V. MAINTENANCE AND REPAIR

I. CAUTION

When trouble shooting, be certain that all personnel are properly placed with respect to the output cable. There is dangerous high voltage present in this supply and it should be serviced only by informed and skilled personnel.

II. POWER SUPPLY TROUBLE VS. APPLICATION

A. The first thing to determine is whether the difficulty is with the power supply or with the application. This can be determined by making the following tests:

1. LOAD DISCONNECT
   Disconnect output cable from load. Hang output cable in air away from ground and all personnel.

2. NO LOAD TEST
   Turn overload control to minimum and overvoltage trip control to maximum. Raise high voltage control (on front panel) until kilovoltmeter reads rated maximum output voltage. Leave on for approximately 15 minutes. If trouble does not develope, then:
   a. Turn HIGH VOLTAGE CONTROL to zero.
   b. Turn unit off.

3. SHORT CIRCUIT TESTS
   Connect the high voltage end of the output cable to ground. Turn the overload TRIP CONTROL (on front panel) fully clockwise. Turn HIGH VOLTAGE CONTROL slowly clockwise until rated output current is reached. Leave on for approximately 15 minutes. A small rotation of the coarse HIGH VOLTAGE CONTROL should give full current. Turn unit off.

B. If the the above tests prove normal power supply operation, the trouble is most likely in the load application. We suggest contacting our representative in your area for assistance.

C. If the power supply operation is not normal, then proceed as follows:

1. If the NO LOAD TEST is satisfactory, and the SHORT CIRCUIT TEST is not, refer to Trouble Shooting Section.

2. If the SHORT CIRCUIT TEST is satisfactory, and the NO LOAD TEST is not, refer to Trouble Shooting Section.

3. If flashing or arc-over occurs in the High Voltage Section before rated output voltage is reached in the NO LOAD TEST, refer to Trouble Shooting Section.

4. If no output voltage or current is obtained in the NO LOAD TEST and the SHORT CIRCUIT TEST, refer to Trouble Shooting Sections III to VI.

III. FLASHING IN HIGH VOLTAGE SECTION:

NOTE: Overload or overvoltage relay may trip after flashover. This can be determined by Pilot light on front panel.

PROBABLE CAUSE	REMEDIAL ACTION
IMPROPER LOAD	
Load may be open or arcing to ground.	Remove load and check unit at no load.
OIL AERATION:*	
This usually occurs when High Voltage Section is untanked frequently. Entrapped air will cause some loss of insulation properties of oil.	Before raising output voltage, allow frame to set in oil approximately 1/2 hour to remove major air pockets. Operate at 3/4 voltage to help drive out excess air.
INSUFFICIENT OIL:*	
Oil level must be approximately 1/4" from top of tank cover.	Fill oil to approximately 1/4" from top of tank cover with the frame in place.
CONTAMINATED OIL:*	
This will lower the dielectric strength of the oil.	Filter or replace oil.
BROKEN LEAD (S):	
Leads may be disconnected and cause arcing.	Inspect High Voltage Section for broken leads on transformers, tubes, capacitors, rectifiers, etc.
FOREIGN MATTER IN HIGH VOLTAGE SECTION	
Objects such as screws, nuts, bits of metal floating above ground potential may cause arcing.	Inspect for foreign matter such as nuts, screws, pieces of wires, etc. wedged in frame or cabinet. Remove.
Output cable not seated properly.	Check to see that cable plug mates properly with jack.

If the cause of flashing is not eliminated by any of the above remedial actions, it will be necessary to remove the frame from the tank and raise the output voltage to 1/3 rated output voltage in air. DO NOT RAISE ABOVE 1/3 RATED VOLTAGE IN AIR. Watch for signs of corona and/or arcing as they usually indicate source of trouble. There is dangerous High Voltage present and extreme caution should be observed.

* Oil insulated units only.

IV. NO OUTPUT CURRENT (Output Voltage O. K.)

Meter range switch in "Transit" position	Remove short
No ground connection	Connect a common ground to load and all metal housings. (Tanks and cabinets).
Calibrating potentiometer in meter circuit shorted.	Check potentiometer for short with ohmeter. Isolate circuit as required.
Defective Meter	Check power supply meter against standard meter.
Open load	Check Load.

If the above does not succeed in locating the difficulty, remove the load and place a milliammeter between output and ground. Observe proper polarity. If current is read, the trouble is probably in the milliammeter circuit in the control section.

Notify our representative in your area for assistance if the above does not remedy your difficulty.

V. NO OUTPUT VOLTAGE (Output Current O. K.)

Meter range in "Transit" position	Remove short
Calibrating potentiometers(across meters)shorted.	Check potentiometer for short with ohmeter. Isolate circuit as required.
Defective meter	Check power supply meter against standard meter.
Load shorted	Check load.

If the above does not succeed in locating the difficulty, remove load and place a kilovoltmeter from output to ground. Raise HIGH VOLTAGE CONTROL until meter reads. (The voltage read is limited by the capability of the external meter). If voltage is being generated, the trouble is probably in the kilovoltmeter circuit. Notify our representative in your area for assistance if the above does not remedy your difficulty, or contact the Service Department, Sorensen/A Unit of Raytheon Co., Richards Ave., South Norwalk, Connecticut.

VI. NO OUTPUT VOLTAGE OR CURRENT

Meter shorted by transit position	Remove short.

No output from variable auto transformer	Check variable auto transformer brushes and input voltage.
Polarity reversal plugs, improperly connected or not connected.	Check for proper seating of reversing plugs.
High voltage transformer defective.	Check to see if any output voltage is obtained by placing an AC kilovoltmeter from the high end of transformer to ground.
High voltage transformer input fuse blown.	Replace fuse. NOTE: The indicating lamp on the front panel will not light unless the HIGH VOLTAGE CONTROL is brought up to about 60 on the dial.

If any of the above does not remedy the difficulty, please call our representative in your area, or contact the Service Department, Sorensen/A Unit of Raytheon, Richards Avenue, South Norwalk, Connecticut.

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